# Influence of superlattice period thickness on strain distribution in GaN/AlN multi-quantum-wells

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Aim of this work was to study influence of the thickness of superlattice period on strain distribution in GaN/AlN multi-quantum-wells (MQWs) by X-ray diffraction (XRD), photoluminescence (PL) and transmission electron microscopy (TEM) techniques. A series of samples consisting of 10 periods of GaN/AlN MQWs were grown by plasma-assisted molecular beam epitaxy (PAMBE) on 1μm-thick (0001)-oriented AlN-on-sapphire templates. The MQWs were grown on 500 nm thick Si-doped AlN layer, and were capped by 50 nm of AlN (also Si-doped). The widths of GaN quantum wells and AlN quantum barriers were equal. For different samples they varied from 1 nm up to 4 nm.

XRD measurements were used to examine structural properties of GaN/AlN superlattices in lateral and vertical directions as well as strain distribution. First, for each sample two types of measurements were done: $2\theta/\omega$ scans of 0002 symmetrical reflection and reciprocal space maps of the $\bar{1}\bar{1}24$ asymmetrical reflections. It allows calculation of the accurate values of lattice parameters of supperlattices and substrates. High-resolution XRD maps show that for the narrowest GaN/AlN MQWs *a*-lattice parameter is similar to Si-doped AlN layer lying directly under the MQW, so it is almost fully strained. We observed that with increasing of GaN/AlN MQWs width the average superlattice *a* in-plane lattice parameter increases to values close to GaN lattice parameter *a*. The structures are partially relaxed. Next the $2\theta/\omega$ scans were simulated using Panalytical X'Pert Epitaxy software utilizing dynamical diffraction theory. We observed the interference oscillations, so-called thickness fringes from experimental and theoretical data coming from MQWs. The fit of these two curves allows us to determine thicknesses of the GaN quantum wells and AlN barriers and the quality of the interfaces. The blurring of the interfaces causes deviations between experimental and calculated data, so TEM measurements help to check the quality of the interfaces in MQWs.

Photoluminescence spectra show that due to Quantum-Confined Stark Effect (QCSE) the PL peak energies of the MQWs decreased with increasing of the width of the AlN quantum barriers and GaN quantum wells.

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